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London Plane at the Arboretum

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Arboretum Activities

Although the winter months constitute a period of dormancy for most growing things at the Arboretum they are by no means a time of forced inactivity for members of the staff. In fact, in many respects there is more concerted work accomplished here from November until March than may be the case during the growing season. This is due largely to the fact that many of our winter operations can be carried out regardless of the state of the weather, whereas inclement conditions during the summer months may interrupt all outdoor plans.

First of all, we must get ready for winter. This

(Continued on page 18)

The Origin and History of the Cultivated Plane-trees

HUI-LIN LI

INTRODUCTION

The familiar Plane-tree, the most widely planted street and shade tree in many American and European cities, is curiously, one of the most badly confused plants in horticulture. The three commonly planted species, the Oriental Plane, the American Plane and the London Plane, because of their generally similar and at the same time extremely variable foliage characters, are often wrongly identified, not only in trade catalogues but also in horticulture literature. The confusion is further aggravated by the uncertain origin of the London Plane, which has baffled horticulturists and botanists for many decades.

The London Plane is unknown in the wild state and apparently originated in cultivation. (See Cover and Fig. 1). In horticulture literature before the early years of the present century, it was generally considered as a variety of the Oriental Plane, and because of this, when the Oriental Plane or *Platanus orientalis* is mentioned in the literature, it may be referable either to the true Oriental Plane or to the London Plane, *P* × *acerifolia*. The prevalent consensus is that the latter is most probably a hybrid between the Oriental Plane and the American Plane, *P. occidentalis*, but the confusion does not abate. (Fig. 2).

Some of the confusion is probably due also to the many common and colloquial names applied to these trees; these names will be discussed below. For the present discussions, the common names used for the three species in question will be Oriental Plane for *P. orientalis*, American Plane for *P. occidentalis* and London Plane for *P.* × *acerifolia*. (Figs. 3, 4 and 5).

The Oriental Plane is one of the oldest and most cherished shade trees cultivated by men, and is still widely planted in many parts of the world. The American Plane came into cultivation during the 16th century, while the London Plane originated as a cultivated tree in about the later part of the 17th century. These three plants are among the most prominent features of the landscapes in many habitats of man's choice, from cities made of modern skyscrapers in America and Europe to towns made of mud huts among the steppes of western and central Asia. The story of the Plane-trees indeed is most instructive in illustrating vividly the mutual influences exerted by man and the surrounding vegetation on each other.

To trace the history of cultivation of the different Plane-trees, especially the mysterious and elusive origin of the London Plane, it is necessary first to take into account the genus *Platanus*, which, aside from the fact that it contains some of the most attractive and valuable shade trees, is a genus that will repay consideration.

THE GENUS PLATANUS

The genus *Platanus* is the only member of the family Platanaceae, a family of special interest because of its isolated position and disputed relationships in the phylogeny of the flowering plants. The 8 or 9 species of *Platanus* are scattered in widely disjunct areas in the Northern Temperate Zone, a pattern of distribution which generally indicates antiquity. Actually the family history of *Platanus* is one of the most majestic, for paleobotanists trace its ancestry back to the

Fig. 1. *Platanus* × *acerifolia* at the Morris Arboretum.

Fig. 2. Leaves of *Platanus occidentalis* (left), *P.* × *acerifolia* (middle), and *P. orientalis* (right).

age of Dinosaurs in the late Cretaceous, some 100 million years ago.

The species of the genus *Platanus* more or less closely resemble each other in general appearance. They are tall deciduous trees with smooth bark shedding in broad, brittle, thin plates and exposing the whitish or brownish inner bark. The leaves are large, palmately lobed with toothed or smooth margins and with the leaf-stalks enlarged at base enclosing the winter buds. There are stipules usually sheathing the base of the leaf-stalks, of varying sizes and often falling off very early. The flowers are of distinct sexes produced on separate inflorescences on the same tree. They are very minute and simple, without perianth and closely packed in hanging globose heads. The fruiting heads remain attached to the tree during the winter on the otherwise bare branches, presenting a graceful appearance. These heads break up in late winter and the hairy fruits are widely distributed by winds. The wood of these trees, light brownish or reddish in color, splits poorly and is thus not highly valued.

There is one species in southeastern Europe and western Asia, *P. orientalis,* the Oriental Plane. In eastern North America, the American Plane, *P. occidentalis,* occupies a wide range from southern Maine to Ontario and Nebraska south to northern Florida and Texas. The variety *glabrata* occurs from central Iowa and Missouri to western Texas and northern Mexico.

In western North America *P. racemosa* occurs in southern California and Lower California, and *P. Wrightii* from New Mexico and Arizona to California and northern Mexico, sometimes planted in the latter region as a shade tree. Also known from Mexico are *P. mexicana* (also occasionally planted as a shade tree), and *P. lindeniana.* In addition, Standley proposes two species from Mexico, *P. chiapensis* and *P. oaxacana.* Thus seven species are recorded as occurring in Mexico, but some of them are local or only little known (Standley 1922). Inasmuch as the species are generally differentiated by leaf-shapes, and as these are extremely variable even on the same tree, it seems likely that as a result of critical monographic studies, fewer species will be recognized.

Paleobotanists have found that in the Tertiary many species of the genus were wide-spread through the northern part of the Northern Hemisphere, in all of Europe, northern Asia and North America north to the Arctic Circle (Seward 1931). Subsequently the Pleistocene glaciation exterminated the more northern populations and surviving species are now confined to the eastern Mediterranean region in the Old World and to eastern and western North America including Mexico. Inasmuch as a large num-

Fig. 3. *Platanus orientalis,* from planted tree, Morris Arboretum.

Fig. 4. *Platanus occidentalis*, from planted tree, Morris Arboretum.

ber of such Tertiary survivals are now found existing mostly in eastern North America and in China and Japan, the entire absence of *Platanus* from eastern Asia seemed to be very remarkable (Berry 1923).

However, in 1939, the French botanists Gagnepain (1939) made an interesting discovery: a plant was found in Loas, Indo-China, which had all the peculiar features of *Platanus* in the flowering structures but with un-lobed, entire-margined, and pinnate-veined ovate-lanceolate leaves. In spite of the striking difference in the vegetative structures, Gagnepain considered the plant as belonging properly to the genus *Platanus* and named it *P. Kerri*. (Fig. 6).

The Indo-Chinese species has a longer inflorescence than all the other species, with 9 to 11 heads in the fruiting clusters. In the other species, the fruiting heads vary from solitary as in the American *P. occidentalis* to 2 to 6 as in the Oriental *P. orientalis* and others. The larger number is considered as a more primitive character and in this sense the Indo-Chinese species probably represents the most primitive species of the genus in existence.

If this proves to be the case, as detailed studies of various other aspects of the plant will verify, the un-lobed entire-margined leaf may indicate a more basic type than the palmately lobed ones, long considered as distinctly characteristic of the genus. This discovery may thus prove of profound significance in the study of the fossil history of the flowering plants, as the genus *Platanus* has long been recognized as one of the most important and abundant of the earlier fossils of the flowering plants. Actually since fossil plants are usually identified by the shape and venation of detached leaves only, such identifications, as is well known among paleobotanists themselves, are frequently not quite reliable. The leaves of this Indo-Chinese species, if discovered in rock strata as fossil imprints, will never be recognized as belonging or even related to *Platanus*. This species, which apparently has not yet been noted by many paleobotanists, indicates that a revision in our interpretation of fossils pertaining to *Platanus* is to be expected.

Fig. 5. *Platanus* × *acerifolia*, from planted tree, Verree Road.

The Oriental Plane

As noted above, the Oriental Plane occurs in southeastern Europe and western Asia, eastward to Kashmir, but the range has apparently been extended through long years of cultivation. Henry (1908) believes that it occurs wild in Albania, Greece, Cyprus, Crete, Rhodes, and Asia Minor, while the occurrence in the wild state elsewhere, such as Iran, Afghanistan, Kashmir, etc., is very doubtful. The wild form he considers to differ slightly from the cultivated form in the slightly smaller leaves with cuneate instead of truncate or cordate leaf-base, but as the range of variation in the shape of the leaves in both the wild and cultivated form is considerable, it is not easy to distinguish the two morphologically. The trees cultivated in England or elsewhere are derived from trees indigenous to Greece and Asia Minor. The leaves of the trees cultivated in Kashmir and Iran are much larger, with broad oblong-triangular segments, and according to Henry, perhaps represent a distinct race.

Since very ancient times, the Oriental Plane has been valued as an ornamental shade tree. Its shelter-giving qualities, the wide-spreading branches and large dense foliage, render it one of the most prized trees in the hot lands of the Near East. With its massive size and great age, it is one of the noblest of all trees and many romantic legends are attached to it.

The Plane-tree was known in the earliest records of Greece. Herodotus tells that Xerxes, when he invaded Greece, was so enchanted with a beautiful Plane-tree that he encircled it with a collar of gold and confided the charge of it to one of his Ten Thousand. Ælians adds that Xerxes passed an entire day under its shade, compelling his whole army to encamp nearby and that this delay was one of the causes of his defeat. He was so fond of this tree that he covered it with gold and gems, styled it "his mistress, his minion, his goddess", and for several days was entirely oblivous to his expedition and army (Loudon 1844).

In the time of Pliny, Plane-trees were planted near all the public schools in Athens. Pliny says that there is "no tree whatsoever which so well defends us from the heat of the sun in summer". We are told that the grooves of Epicurus, in which Aristotle taught his roving disciples, the groves of Academus, in which Plato delivered his celebrated discourses, and the shady walks planted near the Gymnasia and other public buildings of Athens, were all composed of this tree. Homer frequently mentions "the shady Plane". Socrates swore by the Plane-tree, and this was one of the things that offended Melitus, who

Fig. 6. *Platanus Kerri.*

thought it a great crime to swear by so beautiful a tree. (Loudon 1844).

The Plane-tree was also cultivated in Iran from the earliest period, and is still one of the most conspicuous features of its landscape. The Romans were long attracted to this precious and beautiful tree of the Levant. We are told how Licinius Mucianus, when Roman Consul in Lycia, dined in its hollow trunk along with eighteen persons of his retinue. It was introduced into Italy from Greece about 390 B. C. and the Romans planted it extensively in their gardens for shade.

The Oriental Plane seems to have been introduced into England as an ornamental tree about the middle of the 16th century, the exact date being unknown. It was introduced into France from England in about 1754 and into North America apparently in colonial times, although the exact date can not be ascertained.

However, at the present, aside from the Mediterranean region, the Oriental Plane is little planted because of its tenderness. It is now un-

common in Great Britain, where it was replaced by the London Plane more than 150 years ago. However, there are scattered fine old specimens of large size of this species planted some 300 years ago in England (Elwes & Henry 1908).

The Oriental Plane in North America

There seems to be no record extant fixing the date of introduction of the Oriental Plane into North America. Although the Oriental Plane sometimes figures deceptively as an important tree of frequent occurrence in this country, actually it is at present extremely rare in cultivation. What is generally called *"Platanus orientalis"* or "Oriental Plane" in the trade and in the literature nearly always proves to be the London Plane, *P.* × *acerifolia*. The Oriental Plane is indeed one of the most confused plants in horticulture.

This confusion seems to stem from the early concept of considering the London Plane as a variety of the Oriental Plane. Many authors in the past called the London Plane, simply *"P. orientalis"*, without indicating that actually it was meant for *"P. orientalis* var. *acerifolia"*. Though as early as 1908, Henry pointed out clearly that the London Plane, widely planted in the United States, was invariably known by the erroneous name of *"P. orientalis"*, such a confusion in the names persists to this day in the literature. In 1916 Rehder (in Bailey 1916) noted that "The true oriental plane is rare in cult., the tree usually planted under this name being *P. acerifolia*". Henry also stated in 1919 that the Oriental Plane, which is not readily propagated by cuttings, was never used for planting in streets in Europe or North America, and that it was very rare in the latter region.

In a recent work, Wyman (1951)[1] recommends both *P. orientalis* and *P.* × *acerifolia* as trees for American gardens and states that both are planted annually as a street tree by the thousands and that both these species have been grown as clipped screens and arbors in this country. Despite inquiries from various sources, we have not been able to confirm these uses of *P. orientalis* in this country.

As a result of these inquiries and from a study of herbarium materials and the literature, we have come to note only a few alleged trees of *P. orientalis* in this country. In New York City, Croizat (1937) located four trees, two standing in Central Park, one planted in Morningside Park, and one cultivated in the Brooklyn Botanic Garden. He says that all of these are mature plants probably of the same age and same origin, although he gives no indication of either. An accompanying illustration and several preserved herbarium specimens show that these trees are probably correctly identified, although they may also be hybrids resembling more closely *P. orientalis*. He says that the leaves of the Oriental Plane vary bewilderingly. Actually some of the leaves of his Oriental Plane are very close to those of his London Plane given in the same illustration.

Fig. 7. *Platanus orientalis* (?), from planted tree, Verree Road.

In the city of Philadelphia, no less than 158,000 trees are planted along the sidewalks.[2] According to Mr. W. B. Satterthwaite, principal arboriculturist of the city, 50,000 are Plane-trees, and all except two, are London Planes. The two exceptions are probably Oriental Plane, growing along

[1] In Wyman's book, there is mention of trees of *P. orientalis* in New England said to be three or four hundred years old. Upon inquiry, Dr. Wyman admits this to be an error, stating that he meant England instead of New England.

[2] The street trees of Philadelphia are under the jurisdiction of the Fairmount Park Commission. I am indebted to Mr. Satterthwaite for information on the Plane-trees in Philadelphia.

Verree Road in the Fox Chase section of the city. (Fig. 7). Another tree of its kind growing nearby as a street tree is in the town of Ardmore, Pennsylvania.[3]

A resident along Verree Road informs us that the Plane-trees there were planted some twenty-five years ago from seedlings obtained from the nearby Krewson's Nursery. The two supposedly Oriental Plane-trees are somewhat distinct from the numerous other London Planes, being much more slender and more sparsely branched. The outer barks are nearly completely peeled off exposing the smooth silvery grayish inner bark. There are three to five fruiting heads to the cluster. The leaves are deeply 5-7-lobed, with the sinuses reaching below the middle of the leaves. As the trees are trimmed every year we are not aware of any frost-killing of the younger branches.

In addition to the three trees on the records of Fairmount Park, we have discovered a fourth tree, on Paper Mill Road just beyond the city limits near Chestnut Hill. This has the same kind of deeply and narrowly lobed leaves and smooth whitish bark. (Fig. 8). It is a larger tree than those on Verree Road, with the trunk approaching the size of the other London Plane-trees lining the street along with it. These trees are about the same size and age as those on Verree Road and were probably all planted about the same time. The tree along Paper Mill Road, however, bears fruits mostly in clusters of twos.

These four Philadelphia trees of supposedly Oriental Plane identity, like the trees of New York mentioned above, may not be pure *P. orientalis*, but hybrids of *P. orientalis* and *P. occidentalis*. However, instead of showing intermediate characters between the two parent species like most other London Planes, they resemble more closely the former parent. Our supposition is prompted in part by the fact that although the leaves of these trees approach very closely *P. orientalis*, the smooth whitish bark seems to resemble more *P. occidentalis* than it does the former. Without actual records of the origin of these trees, it is not possible to ascertain their true identity, and since these trees approach so closely the features of *P. orientalis*, even though they may be of hybrid origin, they may pass as that species for practical purposes in identification. These plants appear to be especially close to *P. orientalis* var. *cuneata*, which is considered by Henry (1919) as a variety of *P.* × *acerifolia*. (See further discussions under the London Plane.)

[3]Mr. Satterthwaite says that he obtained some cuttings from this tree ten years ago and was able to propagate several trees. One is quite large now and is growing at the west end of site of Horticultural Hall. Cuttings from the other two trees had not proved successful.

Fig. 8. *Platanus orientalis* (?), from planted tree, Paper Mill Road.

In recent years there have been several efforts made in this country to introduce authentic stocks of *P. orientalis* from Europe and the Orient. The Morris Arboretum received in 1954 seed from three sources, from Kashmir through Mrs. Laura Barnes, from Turkey through Dr. Frank Meyer, and from Italy through Dr. Benjamin Blackburn. A number of seedlings were raised but all perished either in the greenhouse or when outplanted except one in the nursery which is now about two feet high. This tree is from seed obtained from Italy. (Fig. 3).

The American Plane

In eastern North America, *Platanus occidentalis* occupies a very wide range from Maine to Ontario westward to Minnesota and southward to Florida and Texas. Within the region it is a common tree, inhabiting especially the borders of streams and lakes and rich bottom-lands. A variety *glabrata*, with smaller, more deeply lobed leaves, but considered as indistinct by some botanists, occurs in central Iowa and Missouri to western Texas and northern Mexico.

The American Plane, attaining to a height of 140-170 feet is, according to Sargent (1895), the most massive if not the tallest deciduous-leaved tree of the North American forest. It is a taller tree than the Oriental Plane and, like the latter, it lives to a great age.

The American Plane can be distinguished from the Oriental Plane by the bark, the leaves, and the fruiting heads. The bark peels off in small thin scales, exposing the large irregular surfaces of almost creamy white instead of flaking in large pieces revealing a dull grayish or greenish white beneath as does the Oriental Plane. The leaves of the American Plane are 3- or sometimes 5-lobed with broad-triangular lobes which are broader than long; while in the Oriental Plane, the leaves are deeply 5-7-lobed, the lobes being narrow, longer than broad, with the sinuses reaching to below the middle of the leaves. (Figs. 2, 3 and 4). In the American Plane, there is generally a single fruiting head borne on a stalk, rarely two together, while in the Oriental Plane, there are 2-7 fruiting heads together. In the American Plane, the old stigmas of the individual achenes are much shorter and consequently the head is much smoother and not as bristly. The achene has a flat or slightly rounded apex while in the Oriental Plane the achene is not only more bristly but always more or less conical or tapering.

The American Plane, known also as Buttonwood or Sycamore, has been planted since the 16th century as an avenue tree or shade tree. It was introduced into English gardens by the younger Tradescant early in the 17th century (Loudon 1848). In England and on the European continent, it is not suited to the climate. Elwes & Henry stated in 1908 that so far as they know there was not a single tree of this species of any size growing in Britain. And the tree was equally rare on the continent; only a few trees were then known to exist in France and none in Germany or Austria. Henry also stated that although seedlings were frequently raised at Kew, they never lived more than a few years and suffered severely from frosts and diseases.

The Plane-trees are especially desirable as street trees because of their ability to withstand smoke and the absence of insect pests, but the American Plane is now little used even in America because it is often severely subject to a blight, also known as anthracnose, caused by a fungus *Gnomonia venera*. The Oriental Plane appears to be practically immune from the attack of this fungus. The London Plane, the history of which we will presently investigate, is almost invariably affected, but to a much lesser degree than the American Plane.

In the horticultural literature of England and Europe, the American Plane, often known as Occidental Plane, is frequently confused with the London Plane, *P.* × *acerifolia*. As pointed out by Elwes and Henry (1908) the confusion between these two plants seems to have begun early and persisted tenaciously. In the opinion of these authors, it is probable that most of the references to the "Occidental Plane" in Great Britain and on the continent of Europe actually refer to *P.* × *acerifolia*.

(To be continued)

Spring Flowering Calendar

John M. Fogg, Jr.

By the time this issue reaches its readers a score or so of plants will already have come into flower at the Arboretum. In some cases the blooms will have appeared and gone; in others, with a more prolonged flowering season, there may still be a show of color.

Included in this group of hardy pioneers, which may be counted on to form the vanguard of late winter and early spring, are the following: the Vernal Witch Hazels *(Hamamelis vernalis, H. japonica, H. mollis* and *H. intermedia);* the Silver and Red Maple *(Acer saccharinum* and *A. rubrum,* which usually flower in mid and late February respectively); the early Dogwoods or Cornelian Cherries *(Cornus officinalis* and *C. mas);* the Wintersweet *(Chimonanthus praecox)*; Winter Jasmine *(Jasminum nudiflorum);* several of the early honeysuckles *(Lonicera Standishii, L. Periusi* and perhaps *L. fragrantissima);* Spice Bush *(Lindera Benzoin)* and, possibly, two of the earliest Rhododendrons of the Azalea group *(Rhododendron mucronulatum* and *R. dauricum).*[1]

Some of these, like the dogwoods, witch hazels and honeysuckles, may respond to a warm spell almost any time during the winter months, although persistent cold weather may prevent the first appearance of their flowers until late February or March. Others, like the maples, seem to

[1]For a fuller discussion of this subject see "Early Flowering Shrubs at the Arboretum" by Martha H. Starr, Vol. 7:12-13 (1956).

be more delicately adjusted to the length of day and the angle of the sun's rays and usually come into bloom on about the same date regardless of temperature. Indeed, the whole subject of phenology, or the relation of plants to weather, is a fascinating one and deserves a great deal of study at the hands of persons who are in a position to conduct observations on both wild and cultivated plants.

Records maintained in this area over a series of many seasons indicate that, in general, most plants can be expected to come into flower on about the same date year after year. Exceptions occur, of course, and during the unusually cold winter and spring of 1956 many plants were as much as two or even three weeks behind schedule.

The following list attempts to express week by week the flowering expectancy during April and May of a number of trees and shrubs found growing at the Arboretum. It has no pretentions to completeness or exactness, but is offered merely as an indication of the dates by which, based on past performance, some of the more familiar plants in the Arboretum may be expected to put forth their first flowers. It is hoped that visitors to the grounds will find it a useful guide. We shall welcome any corrections or additions which they care to pass on to us. It should be recognized that there may well be a difference of several days between blooming dates at the Arboretum and those of localities at a lower altitude even within a radius of a few miles.

BLOOMING DATES

APRIL

First week

Pussy Willow	Salix discolor
Goat Willow	S. caprea
Star Magnolia	Magnolia stellata
Winterhazels	Corylopsis spicata C., sinensis, etc.
Japanese Andromeda	Pieris japonica
Forsythia, Golden Bells	Forsythia ovata

Second week

Hybrid Magnolias	Magnalia Soulangeana, etc.
Kobus Magnolia	Magnolia Kobus
Oregon Grape	Mahonia Aquifolium
Shad-bushes	Amelanchier spp.
Flowering Quince	Chaenomelas lagenaria
Weeping Cherry	Prunus subhirtella pendula
Yoshino Cherry	Prunus yedoensis
Japanese Spurge	Pachysandra terminalis
Periwinkle, Ground Myrtle	Vinca minor

Third week

Oriental Cherry	Prunus serrulata
Thunberg Spiraea	Spiraea Thunbergii
Bridal Wreath	Spiraea prunifolia
Red-bud, Judas Tree	Cercis canadensis
Ohio Buckeye	Aesculus glabra
Silver Bell	Halesia monticola
Enkianthus	Enkianthus perulatus
Royal Azalea	Rhododendron Schlippenbachii
Carles' Viburnum	Viburnum Carlesii

Fourth week

Kerria	Kerria japonica
Wisterias	Wisteria spp.
Hardy Orange	Poncirus trifoliata
Flowering Dogwood	Cornus florida
Kurume Azaleas	Rhododendron obtusum
Snow Azalea	R. mucronatum
Skinner Hybrid Azaleas	R. spp.
Lilacs	Syringa spp.
Tartarian Honeysuckle	Lonicera tatarica

MAY

First week

Jet-bead Shrub	Rhodotypus kerrioides
Pearl Bush	Exochorda racemosa
Fringe Tree	Chionanthus virginica
Japanese Snowball	Viburnum tomentosum
Tree Peonies	Paeonia suffruticosa
Neviusia	Neviusia alabamensis
Glenn Dale Hybrid Azaleas	Rhododendron spp.

Second week

Cucumber Tree	Magnolia acuminata
Flowering Crabs	Malus spp.
Neillia	Neillia sinensis
Van Houtte's Spiraea	Spiraea Van Houttei
Black Locust	Robinia pseudoacacia

Third week

Umbrella Tree	Magnolia tripetala
Sweetshrub	Calycanthus floridus
Mock Oranges	Philadelphus spp.
Yellow Wood	Cladrastis lutea
Princess Tree	Paulownia tomentosa
Leucothoe	Leucothoe editorum
Weigelias	Diervilla spp.

Fourth week

Deutzias	Deutzia gracilis, D. parviflora, etc.
Ninebark	Physocarpus opulifolius
Mountain Ash	Sorbus americana
Horse-chestnut	Aesculus Hippocastanum
Butterfly Bushes	Buddleia spp.
Beauty Bush	Kolkwitzia amabilis

Although the species on the above list are all woody, it is worth pointing out that there are many herbaceous plants in the Arboretum that merit observation. The Snowdrops *(Galanthus)*, the Snowflakes *(Leucojum)* and some of the Squills *(Scilla)* usually start flowering in February and may continue until the middle or the end of March. Grape Hyacinth (Muscari) is another early bloomer which makes a fine showing in the woodlands along the Wissahickon in March.

Early April marks the appearance of Narcissus with its infinite variety of color forms. Some of the plants in the Rock Wall around the Rose Garden begin flowering in mid April and by early May the three sides of this wall garden display a riot of color.

Cultivated Firs in the Philadelphia Area

JONATHAN W. WRIGHT[1]

The genus *Abies* (fir) is one of the largest of the coniferous genera. It contains about 50 species, distributed from Guatemala to northern Canada in the New World, and from northern Africa to Siberia in the Old World. Along the Pacific Coast of North America some species descend to low elevations in temperate climates, but most of the firs grow in relatively inaccessible mountain areas. Only the northern species have extensive, continuous lowland ranges.

In the Old World the firs are relatively unimportant commercially because of their inaccessability and because their light, weak wood is unsuited for uses requiring much strength. Several of the New World species are important producers of high-grade pulp used in products such as newsprint, rayon, and cellophane. As the forest economy in a fir-growing region changes from lumber production to pulpwood production, the relative economic importance of the firs in that region increases. This trend will probably continue because the shade-tolerance of the firs causes them to increase in relative amount after logging of the lumber-producing species.

To most laymen, and perhaps to many economists, the firs are most important as Christmas trees. Indeed, it was the European silver fir (*Abies alba* Mill.) that gave its name to the Christmas carol *"O Tannenbaum."* The balsam fir (*A. balsamea* (L.) Mill.) is the premier Christmas tree in the Northeast, where over 6,000,000 were cut in 1955 (Sowder, 1956). Other species of fir are used as Christmas trees in the western United States.

The balsam fir furnishes two unique products – Canada balsam and balsam pillows. Canada balsam is a pitchy substance derived from bark blisters. It owes its commercial importance to its transparency and to its index of refraction, which is nearly the same as that of glass. These properties make it ideal for the preparation of microscope slides and the cementing of microscope and camera lenses. Balsam pillows are prepared from balsam fir needles. They cannot compete with feather or foam rubber pillows in softness, but they do have a delicious fragrance that lasts for years.

The firs have several characteristics that make them valuable for landscape plantings, especially on large lots. They have dense, dark, evergreen foliage; they have narrow, pyramidal crowns; they grow better than most other conifers in the shade; and they are hardy and relatively free from pests. The stately Greek fir (*A. cephalonica* Loud.) makes an excellent specimen tree; so do many other European and Japanese species. The wide-spreading Nikko fir (*A. homolepis* Sieb. and Zucc.) can be used as a specimen tree or as a shade tree. Because of their ability to grow in dense shade, several species are ideal for planting under existing deciduous trees to brighten up an otherwise drab winter landscape. Under such conditions the firs grow more slowly than they would in the open, but they will live for years and grow into big trees if the overhead shade is removed.

TAXONOMIC CHARACTERISTICS

Fir needles are of medium length (½ to 2½ inches long); they are borne singly; they are usually blunt and bifid at the apex; they are usually flattened; with stomata only on the lower surface; and they are all of approximately the same length. The cones are erect; they fall apart while on the tree, leaving the central axis for years as a mute reminder of past seed-bearing; they are borne only on the uppermost branches. One or more of these characteristics may be used to distinguish fir from pine (needles borne in groups of 2 to 5 cones borne on middle or lower branches as well as upper branches); spruce (sharp needles, pendant cones); hemlock (short needles of varying lengths, small cones borne over entire crown); Douglas-fir (pendant cones born over entire crown), and other common conifers.

Distinguishing one fir from another would be an easy task if we knew the geographic origin of each specimen because there is usually one and only one species in a given native fir forest. Unfortunately, data on seed origin are almost always lacking. Therefore we must use cones or twigs for identification. The cones contain many good diagnostic characters but they are usually out of reach on tall trees. When using twig material for identification it is necessary to pay close attention to details such as degree of pubescence,

[1]The author is Geneticist, Northeastern Forest Experiment Station, U. S. Forest Service, Upper Darby, Pa. He is stationed at the Morris Arboretum, where many of the observations recorded in this paper were made, in cooperation with the University of Pennsylvania.

needle arrangement, number of lines of stomata, resin on the buds, and general vigor of the tree. There are a few species that have one or two characteristics that are distinctive enough for easy and positive identification. Among such species in Philadelphia are balsam fir (low vigor), Nikko fir (broad crown, grooved branchlets), Spanish fir (*A. Pinsapo* Boiss.; entire, sharp-pointed needles), Momi fir (*A. firma* Sieb. and Zucc.; bifid, sharp-pointed needles), and corkbark fir (*A. lasiocarpa* (Hook.) Nuttall var *arizonica* (Merriam) Lemmon; blue foliage).

Performance in the Philadelphia Area

In a brief paper such as this it is impossible to do more than mention the highlights of the most important species. Therefore Table 1 was prepared to give growth information about all species that have been tested in Philadelphia, Pa., or Rochester, N. Y.[2] In general the correspondence between observations made on the same species in Philadelphia and in Rochester has been great enough to make it possible to use the observations interchangeably.

The reader interested in the performance of exotic firs in other sections of the Northeast is referred to papers by Sargent (1898), Slavin (1932), and Harkness (1953).

Nomenclature in this paper follows Rehder (1949), Little (1953), or Martinez (1953) whenever possible. The references to *A. equi-trojani* Aschers. and Sint. and to *A. sikokiana* Nakai were taken from Mattfeld (1926) and Hayashi (1951) respectively.

Geographic Origin and Growth in the Northeast

The most logical way to classify the firs is by geographic origin. Except in Japan the species from any particular region tend to be more similar to each other in taxonomic characteristics than they are to species from other regions. For example, the presence of stomata on the upper leaf surface is limited mostly to species from western America, grooved branchlets are found only in three species from eastern Asia, and cones more than 5 inches long are found principally in species native to the Mediterranean basin.

This similarity among species from the same geographic region applies to growth as well as to taxonomic characteristics. For that reason, it is possible to generalize as has been done in the following tabulation:

	Growth rate and general appearance in Philadelphia or Rochester	
Region of origin	*Growth*	*Appearance*
Eastern United States	Slow	Poor
Rocky Mountains	Moderate	Good
Western United States	Slow	Good
Japan	Rapid	Good
Northern Eurasia	Slow	Poor
Mediterranean Basin	Rapid	Good

The American Firs

White fir (*A. concolor* (Gord.) Hoopes) is the most commonly planted species of fir (Fig. 9). It is found in towns and cities throughout Pennsylvania and New York. This species is the most vigorous of the American firs in Philadelphia, and Harkness (1953) regards it as the most reliable of all firs for the Rochester area.

The white fir has a large natural range in the Rocky Mountains and the Sierra Nevadas, where it grows up to 250 feet tall. It is very likely that the Sierra Nevada population should be considered as a distinct geographic variety, *Abies concolor* var. *Lowiana* (Gord.) Hoopes. Trees from

Fig. 9. The light blue green foliage of the white fir contrasts with the dark green of other evergreens.

[2]Many of the measurements of Rochester trees were made by Bernard Harkness, Rochester Park Department.

Table 1. *Maximum sizes and growth rates of individual open-grown specimens or fir growing in Philadelphia, Pa., and Rochester, N. Y.*[1]

Common name	Scientific name, *Abies*–	Trees measured	Age	Total height	Height growth per year	Diameter breast high	Where seen[2]
		Number	*Years*	*Feet*	*Feet*	*Inches*	
	UNITED STATES AND CANADIAN FIRS						
Balsam	*balsamea*	26	29	28	0.9	8	HR*W*
Fraser	*Fraseri*	3	48	20	.4	6	*W*
White	*concolor*	41	60	70	1.2	24	HM*R*W
Subalpine	*lasiocarpa*	10	55	53	1.0	12	HM*R*W
Corkbark	*l.* var. *arizonica*	3	15	13	.8	4	HMR
California red	*magnifica*	1	20	2	.1	–	W
Noble	*procera*	7	50	18	.4	5	R*W*
Grand	*grandis*	2	5	3	.6	–	*W*
Pacific silver	*amabilis*	2	19	9	.4	2	R*W*
	MEDITERRANEAN FIRS						
Silver	*alba*	7	15	6	.4	–	*H*RW
Weeping silver	*a.f. pendula*	2	–	24	–	4	*M*R
Nordmann	*Nordmanniana*	16	35	55	1.6	13	HM*R*W
Cilician	*cilicica*	10	30	58	1.9	14	MR*W*
Greek	*cephalonica*	16	50	75	1.5	26	HMRW
Spanish	*Pinsapo*	3	20	7	.3	–	*W*
———	*Borisii-regis*	1	9	6	.7	–	*H*
Algerian	*numidica*	8	28	58	2.1	14	H*W*
	JAPANESE FIRS						
Sakhalin	*sachalinensis*	3	34	27	.7	7	*R*
Veitch	*Veitchii*	29	43	44	1.0	14	HMRW
Maries	*Mariesii*	6	22	29	1.3	6	M*W*
Momi	*firma*	9	22	21	1.0	5	H*W*
Nikko	*homolepsis*	28	30	43	1.4	11	HMR*W*
	SIBERIAN AND KOREAN FIRS						
Korean	*koreana*	3	42	17	.4	5	*R*W
Siberian	*sibirica*	2	48	50	1.0	9	*R*W
Khingan	*nephrolepis*	2	30	29	1.0	7	*R*W
Needle	*holophylla*	7	30	30	1.0	8	*M*W
	CHINESE FIRS						
Farges	*Fargesii*	1	11	5	.4	–	*R*
Ernest	*Ernesti*	2	29	40	1.3	7	*R*
Min	*recurvata*	3	40	27	.7	7	*R*

[1]Data are not available for the following species: *A. venusta* (United States); *A. durangensis, A. guatemalensis, A. Hickeli, A. Vejari, A. mexicana, A. oaxacana, A. religiosa* (Mexico); *A. marocana* (Morocco); *A. Borisii-regis* (Greece); *A. nebrodensis* (Sicily); *A. Bornmuelleriana, A. equi-trojani* (Turkey); *A. sikokiana* (Japan); *A. Pindrow* (Himalayas); *A. Kawakamii* (Formosa); *A. squamata, A. sutchuensis, A. Faxoniana, A. Georgei, A. Fabri, A. Delavavi,* and *A. chensiensis* (western China). The small, continuously frosted specimen of the Himalayan *A. spectabilis* mentioned by Slavin (1932) in Rochester is no longer living.

[2]H=Haverford College, Haverford, Pa.; M=Morris Arboretum, Philadelphia, Pa.; R=Durand Eastman and Highland Parks, Rochester, N. Y.; W=Westtown School, Westtown, Pa. Italics show the Arboretum in which the largest tree is located.

the Rocky Mountains are preferable for planting in the Northeast because most ecotypes and species from the Pacific Coast states are unsatisfactory here.

Several specimens on the grounds of the former H. W. Sargent estate at Beacon, N. Y., (on the lower Hudson River) testify that the white fir can become a large tree in the East. These are about 80 years old. The largest is 82 feet tall, 25 inches in diameter, and is still thrifty. Some of the specimens in the Rochester public parks are almost as large.

The subalpine fir (*A. lasiocarpa* (Hook.) Nutt.) grows naturally at high elevations in the Rocky Mountains from New Mexico to Alaska and in the Cascade Mountains of Oregon and Washington. In its native habitat its tall, spire-like crown makes it a distinctive feature of the mountain landscape. It retains this spire-like crown when planted in the East.

The corkbark fir (Fig. 10) from the southern Rocky Mountains is usually considered as a geographic variety of the subalpine fir, but is quite different from that species in color and form. Its foliage is almost as blue as is that of the blue spruce. This tree grows very slowly, and is useful for foundation plantings and small gardens.

The balsam fir has the largest natural range of any of the firs – from West Virginia north to Newfoundland and westward across Canada nearly to Alaska. However, it seems to be one of the most unsatisfactory species for planting outside its natural range. Even in Williamstown, Mass., just a few miles from native stands, planted balsam firs have grown more slowly than three exotic species planted at the same time. Living specimens in Philadelphia and Rochester are characterized by short, sparse foliage totally unlike that of wild trees.

Fig. 10. The slow-growing corkbark fir has the bluest foliage of the firs.

Fig. 11. Nordmann fir is very resistant to damage by late spring frosts.

Mediterranean Basin Firs

The firs of the Mediterranean basin have an interesting pattern of geographic distribution. Eight of the species have separate ranges. Only in parts of Greece is there slight overlapping, which involves three species. Five of the species have ranges that are smaller than some Pennsylvania counties. In several instances the taxonomic differences between species are proportional to the distance between the species. A distribution and variation pattern such as this is characteristic of groups that have evolved in place from a common ancestor and in which geographic isolation has been a major factor in promoting species differentiation.

The Greek fir grows at elevations of 2,700 to 5,500 feet in the mountains of Greece. Rapid growth, dark-green foliage, and a dense crown make the Greek fir one of the best of the exotic

species for planting in Philadelphia. It has been distributed by several nurseries, and there are many large specimens in arboreta and private estates. In its native forests the Greek fir reaches heights of 90 to 100 feet. It promises to do almost as well in this country; an 80-year-old specimen on the former Wodlet estate near Beacon, N. Y. is 82 feet tall, 27 inches in diameter, and still growing vigorously. This species has proved quite hardy in the Boston area (Sargent, 1898), but has suffered slight winter-burning in Rochester (Harkness, 1953).

Cone-collecting in Greek fir is apt to be a major undertaking. The cones are large and resinous. Also, they are borne only on the uppermost branches, within 2 or 3 feet of the top of the tree, somewhat above the safe climbing limit.

If the top of a vigorous Greek fir is broken or cut off, several small trunks develop in its place. The Greek natives in isolated mountain districts use this characteristic to good advantage, harvesting the small trunks of injured trees for local construction work.

The Nordmann fir (*A. Nordmanniana* (Steven) Spach) is a native of the western Caucasus and the mountains of northeastern Turkey (Fig. 11). There it grows with oriental spruce and other high altitude species. It has dark-greeen foliage and a very dense crown. The needles spread outward and forward, almost hiding the twig from sight. This species should make an excellent Christmas tree as well as a good specimen tree.

Fig. 13. Injury to the top caused some of the lower branches to ascend in this Cilician fir. The ascending branches have many of the characteristics of trunks, and bear cones.

Fig. 12. The Cilician fir finds itself as much at home as does the Lebanon cedar with which it grows naturally.

In western Turkey there are two little-known firs, *A. Bornmuelleriana* Mattf. and *A. equi-trojani*, that are perhaps best regarded as intermediates between the Greek and Nordmann firs (Mattfeld, 1926). These species should be tried in the Philadelphia area as soon as possible.

The Cilician fir (*A. cilicica* Anat. and Kotschy) is similar to the Nordmann fir in general appearance and growth rate (Figs. 12 and 13). It is a native of southern Turkey and northern Syria, where it often grows with the cedar of Lebanon. This species is found in most arboreta and in many private estates. It makes a good specimen tree and should be acceptable as a Christmas tree.

The silver fir has the largest natural range of any of the European species. It grows on high mountains from the Pyrenees to central Germany and south to the toe of Italy and Rumania. In Greece it seems to cross with the Greek fir, forming the intermediate species *A. Borisii-regis* Mattf. (Mattfeld, 1926). The silver fir has not been so satisfactory in the Northeast as have the other Mediterranean basin species. Perhaps this is due to the use of improper seed origins (presumably the southern origins would be the best);

a few Philadelphia specimens are full-crowned whereas others are very unthrifty.

The Algerian fir (*A. numidica* DeLannoy ex Carr.) is an example of a limited-range endemic species that grows rapidly when transferred to a different part of the world. Its natural range covers only a few square miles on Mt. Babor, Algeria (Mattfeld, 1926), but it promises to be the fastest growing fir in the Philadelphia area. It possesses great promise as a Christmas tree because of its pyramidal form and because of the great color contrast between the lower (whitish) and upper (dark green) leaf surfaces. A nurseryman sent in a specimen for identification recently. He has been selling cut branches from specimen trees for Christmas greens. The demand for these greens is now so great that he wishes to establish special Christmas green plantings. If he plants more than a few acres, he may well double the number of trees in existence!

Japanese Firs

Unlike the Mediterranean species, the Japanese firs have overlapping ranges. In fact, four of the six species occur on one mountain in central Honshu. Most of the Japanese species are taxonomically more different from each other than are species with adjacent or overlapping ranges in other parts of the world. Such a distribution and variation pattern is characteristic of groups in which the species evolved separately elsewhere (in China in this instance?) and moved to their present ranges only after they were distinct enough to be unable to cross readily with each other.

Fig. 14. The Nikko fir has a dense, broad crown.

The Nikko fir (Fig. 14) from central Honshu and Shikoku is the most commonly planted of the Japanese firs. This species is known to be hardy in the Berkshire Mountains of western Massachusetts. On the Cluett estate near Williamstown, Mass. there are three 35-year-old specimens which are growing rapidly and show no signs of winter injury.

The Nikko fir has a broader and less dense crown than most firs. The crowns are usually ½ to ⅔ as broad as tall; one Morris Arboretum specimen is broader than tall. In some trees the lower branches are shorter than the upper branches.

The Veitch fir (*A. Veitchii* Lindley) was named after J. G. Veitch, a pioneer English plant explorer and nurseryman, who brought seeds of it back from Mt. Fujiyama in 1861. It grows on a few mountains in central Honshu. In the leaves of the Veitch fir there is a marked color contrast between the upper and lower surfaces. This characteristic and its pyramidal crown make it an excellent Christmas tree or specimen tree.

The Maries fir (*A. Mariesii* Mast.) and the Momi fir are known in Philadelphia from only a few arboretum specimens. Both are doing well and can be recommended for Christmas trees or lawn trees. The Sakhalin fir (*A. sachalinensis* Mast.) from Sakhalin and the Kurile Islands grows slowly and is thin-crowned in Philadelphia.

Other Asiatic Firs

The needle fir (*A. holophylla* Max.) derives its common and scientific names from its long, entire, sharp needles (Fig. 15). In fact, one could easily mistake it for a spruce after a quick brush against the foliage. It has an open, regular crown, and does well in a variety of situations.

The Siberian fir (*A. sibirica* Ledeb.) has a wide range across Siberia. Strangely, it suffers from late frost damage when planted in lowland parts of the Northeast. This is a common failing in northern species that are moved southward. They have become adapted to a short season, and start to grow at the first hint of warm weather. However, I have seen one satisfactory plantation of this species, at an elevation of 1,100 feet near Forestville, N. Y. Rather, I saw the remnants of the planting, for most of the trees had been sold.

Fig. 13. The needle fir would make an excellent Christmas tree.

The owner, Mr. F. E. Stewart, reported that the Siberian fir had grown a little faster than white fir, had suffered occasional frost damage, and had been as salable as white, balsam, and Fraser firs planted at the same time.

E. H. Wilson was a plant explorer who traveled widely in western China during the early part of this century. The specific epithet *Wilsonii* is common, but rarely do we find Wilson's first name used as in the Ernest fir *(A. Ernesti* Rehd.) This species has a relatively small range in the Tatu River watershed of Sikang. It is very thrifty in Rochester and has a narrow pyramidal crown.

Where to Obtain Fir Seed and Planting Stock

The availability of fir seed and planting stock is shown in Table 2. Some species not listed in that table may be available occasionally from small nurseries that do not publish catalogues.

When ordering seed it is well to specify that the seed be fresh (fir seed does not store as well as that of most other conifers), that the seed be collected within the native range of the species, and the geographic origin of the seed be shown on the label. Knowing the geographic origin is one of the best ways of guaranteeing the true identity of the seed. For example, one dealer lists Nordmann fir seed of central European and southern European origins. Because this species grows only in Asia Minor, the seed is probably not true to name.

Table 2. — *Numbers of nurseries and seedhouses handling species of fir, 1951 to 1956*[1]

Species, *Abies* —	Nurseries	Seedhouses
	Number	*Number*
AMERICAN SPECIES		
balsamea	8	3
Fraseri	3	1
concolor	4	7
lasiocarpa	2	3
lasiocarpa var. *arizonica*	1	0
magnifica	0	3
procera	0	2
grandis	1	4
amabilis	0	3
MEDITERRANEAN SPECIES		
alba	1	2
Nordmanniana	2	2
cilicica	0	2
cephalonica	1	2
Pinsapo	1	2
numidica	0	2
JAPANESE AND KOREAN SPECIES		
sachalinensis	0	1
Veitchii	2	2
holophylla	2	0
Mariesii	0	2
Firma	0	2
homolepis	0	2

[1]This list was compiled from American nursery and seed catalogues in the library of the Morris Arboretum.

As a general rule, it is well to avoid seed collected from specimens planted in this country. This is especially true with regard to the rare species. Most of the large, fruiting firs are so isolated that they receive very little cross-pollination. The few filled seeds produced (usually less than 5 percent) on these isolated trees are probably the result of selfing (which gives trees of low vigor) or of crossing with other species.

Persons interested in large numbers of seedlings of uncommon species would do well to contract with a nurseryman experienced in growing coniferous stock for the production of the seedlings. They can be raised under much the same conditions as spruce save that the seed should be fall-sown and the seedbeds should be given extra shade during the first year and possibly part of the second year.

There has been very little vegetative propagation work done on the firs. Air-layering is probably the surest way of producing a few trees of species for which seed is not available.

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Arboretum Activities

(Continued from page 2)

means that the branches of many of the smaller conifers and some broad-leaved evergreen shrubs must be bound up so that they look like Christmas trees loaded on a freight car for shipment. This prevents serious injury at time of heavy wet snowfalls or ice-storms. The rose garden must be mulched with a thick layer of straw and manure. A mulch must also be applied to any new beds which it is planned to dig during the winter, for such an application keeps the soil beneath from freezing and makes it possible to get a head start with spring planting operations.

Winter is, above all, a time for "housecleaning." The dead branches of evergreens may now be removed and the pruning of deciduous trees and such shrubs as are not early bloomers accomplished. The hundreds of plants in the rose garden are severely pruned. Dead or dying trees are taken down, the trunks and large limbs cut into sections and the litter transported to the dump heap.

Repairs to service roads consume a considerable amount of time and effort. Painting and minor repairs to greenhouses and other buildings engage the full time services of two members of the staff. Machinery must be overhauled: spray pumps cleaned, tractors and grass-cutting equipment put into shape, cutting tools sharpened. Pots must be washed and stored according to size, ready for instant use in the spring.

A certain amount of planting is carried on all during the dormant months. This is especially true in areas where, as indicated above, the ground is covered with a mulch. For example, a strip designed to accommodate a new planting of Glenn Dale azaleas was so treated in November, the bed was dug and prepared in February and the plants set out in March. It is fully expected that these azaleas will produce a goodly display of color this May. Such an accomplishment would be impossible if we accepted winter as a period of suspended animation.

The dormant months are also a time when a substantial amount of propagation can be initiated. Seeds of many plants are started in winter and hardwood cuttings of evergreens and flowering shrubs can be taken.

The making of labels is primarily a winter operation. Hundreds of new stainless steel labels are needed each year not only for plants which are added to the collection but also to replace labels which are stolen. Countless lead labels are also used to identify plants growing in the slathouse, cold frames and nurseries prior to being moved to their permanent positions on the grounds.

One of the most important undertakings in any arboretum is the careful maintenance of accurate records of all plants included in its collections. This means keeping for each specimen an individual file card on which is recorded its history from the day it is received here until the time when it dies and is taken down or removed. There are often as many as eight separate steps necessary in preserving a complete "pedigree" of each of the thousands of plants growing at the Morris Arboretum. Without the preservation of a precise and detailed history of the specimens in our collection, the kind of scientific work which goes on quietly here behind the scenes would be impossible. Among other winter undertakings, closely related to the maintenance of records, are the mapping of all sections of the grounds (which can best be conducted during the non-growing season) and the taking of inventory of all nursery stock.

It will be seen, therefore, that the winter months, instead of representing a period of hibernation at the Arboretum, are rather a season of intense activity.

J. M. F., Jr.

Soil Acidity Preferences of Selected Woody Plants

EDGAR T. WHERRY[1]

As a result of the observations and writings of the late Frederick V. Coville, and many subsequent workers, horticulturists now generally realize that soil reaction, – that is acidity vs. alkalinity – is a factor that one must take into account in setting out plants. Collaborating with Dr. Coville for a number of years, the writer worked out methods for ascertaining the degree of acidity of soils in the field by the use of indicators, – dyes capable of changing their color in response to reaction. First published in 1920, this method has now come into general use.

At this point it may well be pointed out that, while it is true that acids taste sour, many so-called "sour" soils are not acid at all, but on testing with the indicators prove to be distinctly alkaline. The term sour is here being used, thus, in the sense of abnormal or distorted, like a sour note in music or a sour look one gives to a disliked person. For instance, the appearance of mosses in a grassy lawn does not necessarily mean that the soil is acid at all, – it is merely sterile. Before drawing any conclusions as to the reaction of individual sites, tests with indicators should always be made first.

Such tests show that in the general region of Philadelphia the soils are on the whole rather acidic in character, except in the limestone areas of the Whitemarsh-Chester Valley, where neutral conditions are more frequent. When setting out ornamental plants, it is manifestly desirable to select those adapted to the conditions of the specific site; but few dealer's catalogs furnish adequate information as to acidity preferences of individual sorts. At the request of the late Dr. Liberty Hyde Bailey, the writer contributed data as to species of horticultural interest for his work, Hortus, and these will be found in the first and second editions under the heading, Soils. As requests for more information are frequently received, however, some notes on observations of woody plants are here presented.

Should the soil of a given area show on testing a definitely acid reaction, the one woody plant group from which ornamentals will surely be selected is the Heath Family or Ericaceae. To this belong the numerous Rhododendrons – including Azaleas – together with various lesser genera, notably *Andromeda, Arctostaphylos, Calluna, Chimaphila, Clethra, Epigaea, Erica, Gaultheria, Gaylussacia, Kalmia, Ledum, Leiophyllum, Leucothoe, Lyonia, Menziesia, Oxydendrum, Pieris, Pyrola, Vaccinium,* and *Zenobia.* With minor exceptions, and in temperate climates, the species belonging to these genera thrive only in acid soils. If planted where the reaction is circumneutral – i.e., barely acid, neutral, or slightly alkaline, as is the case in cultivated land where lime, compost, commercial fertilizers, etc. have been applied – such plants soon develop "pattern-chlorosis." The leaves turn yellow, with only the tracery of the veins exhibiting the normal green. They may continue to bloom for a season or two, but before long weaken and die. Leafspots and other parasitic fungi, if by chance introduced, spread rapidly and hasten the process.

Some 30 years ago the Bulletin of Popular Information of the Arnold Arboretum carried a note to the effect that *Rhododendron roseum* differs from related species in growing in limy soil, so could well be planted in ordinary (non-acid) gardens. As this was wholly contrary to Dr. Coville's experience, he asked me to look into the matter. Professor Sargent stated that his information had come from John Dunbar, then in charge of horticulture in the Rochester Parks. A trip was soon arranged, and Mr. Dunbar took me to the town of Leroy, and pointed out a fine colony of this Azalea at the top of one of the largest limestone quarries of the State of New York. On climbing up there, however, we found the shrub to be growing not in limestone at all, but in a bed of silica rock, and the reaction of the soil around its major roots to be subacid. This observation was duly published by Dr. Coville (and more recently by the writer in the National Horticultural Magazine) ; but alas, corrections seem never to catch up with mistakes, and the misunderstanding as to the soil acidity preference of *Rhododendron roseum* is still perpetuated by one horticultural writer after another.

While in no other woody plant family do the bulk of the members prefer acid soils, the following 25 native American species, and some of their relatives, do belong in this category:

Acer pennsylvanicum
Aronia arbutifolia
Betula lenta
Castanea dentata
Ceanothus americanus
Chamaecyparis thyoides
Chionanthus virginica
Comptonia asplenifolia
Cornus florida
Fothergilla Gardeni
Franklinia alatamaha
Gordonia Lasianthus
Halesia tetraptera
Ilex opaca

[1]Dr. Wherry's article "Notes on the Geology and Ecology of the Morris Arboretum," which appeared in Vol. 6, No. 4, pp. 38-42, of this Bulletin, elicited so much interest in the relationships between plants and soils that we have invited him to prepare the present article. ED.

Juniperus horizontalis	Spiraea tomentosa
Magnolia virginiana	Stewartia Malacodendron
Picea rubens	Styrax americana
Pinus rigida	Symplocos tinctoria
Quercus rubra	Tsuga canadensis
(and other Red Oaks)	Viburnum acerifolium

Little information is as yet available as to species from foreign countries, but a list can be given of genera of which most species (both native and exotic) seem relatively indifferent to soil reaction, and so can be used in areas shown by indicators to be circumneutral: *Abelia, Acer, Aesculus, Berberis, Buddleia, Buxus, Callicarpa, Celastrus, Clematis, Cotoneaster, Crataegus, Deutzia, Euonymus, Fagus, Forsythia, Fraxinus, Hedera, Hydrangea, Juglans, Juniperus, Ligustrum, Lonicera, Philadelphus, Prunus, Pyrus, Rhamnus, Ribes, Rosa, Spiraea, Syringa, Taxodium, Taxus, Thuja, Ulmus,* and *Wisteria.*

New Associates

The Arboretum is happy to welcome the following new Associates who have been enrolled since December, 1956:

Mrs. C. J. Allen, Jr.
Mr. Thomas S. Ambler
Mr. H. E. Baton, Jr.
Mrs. Russell A. Bell
Mr. James T. Brothers
Mrs. David W. Clark
Mr. I. A. Clarke
Mr. and Mrs. Adrian L. DeWindt
Mr. John A. Doppel
Mr. and Mrs. Harry Duncan
Mrs. Irwin V. Dutton
Mrs. A. M. Freeman, Jr.
Mrs. J. Howard French
Miss Julia W. Frick
Mrs. Leslie Henderson
Mrs. Paul L. Lewis
Mr. and Mrs. Robert H. Lysle
Mr. Paul L. McCloskey
Dr. Thomas P. McCutcheon
Mr. James A. McQuail, Jr.
Mr. Newcomb T. Montgomery
Mrs. Harrison S. Morris
Mrs. Carson L. Mort
Dr. Edward S. Rothman
Mrs. George R. Shaefer
Mrs. William Hill Steeble
Mr. Norman Taylor
Mrs. Edward Weiss

Notes on THE GENUS PHLOX, Arboretum Monograph III, by Edgar T. Wherry.

The following misprints have been noted:

p. 14, col. 1, line 12, for 121° read 120°.
p. 62, col. 2, line 1, after tharpii insert (Whitehouse).
p. 64, col. 1, line 15, for 1947 read 1847.
p. 111, col. 2, line 4, for ^{1} read ^{2}.
p. 137, col. 1, line 13, for mm. read cm.
p. 137, col. 1, line 23, for 15:2 read 15:3.
p. 137, col. 1, line 27, for 15:3 read 15:2.
p. 137, col. 2, line 12, for mm. read cm.
p. 146, col. 1, line 22, for 17:1 read 17:2.
p. 146, col. 1, line 26, for 17:2 read 17:1.
p. 164, col. 1, line 3, for Status novus read Comb. nova.
p. 166, col. 1, line 13, for Infor . . . read Inflor. . .
p. 166, col. 2, line 3, for 1934 read 1834.

The staff of the Bailey Hortorium disagreed with my interpretations of certain rules of nomenclature followed in making new combinations. While I do not concur with them, in order to render my namings usable in their new edition of Hortus, those in question have been republished in Baileya 4: 97, 1956.

E. T. W.